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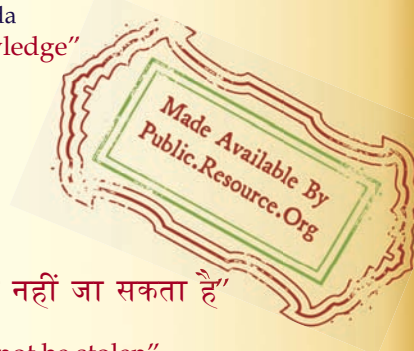
IS 13647 (1993): Electroplated coatings of rhodium for engineering purposes [MTD 7: Light Metals and their Alloys]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक

इंजीनियरी प्रयोजनों के लिए रोडियम का विद्युत निक्षेपित लेपन —
विशिष्ट

Indian Standard

**ELECTROPLATED COATINGS OF RHODIUM
FOR ENGINEERING PURPOSES —
SPECIFICATION**

UDC 669.235.87 : 621.357.7

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NEW DELHI 110002

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Metallic and Non-Metallic Finishes Sectional Committee had been approved by the Metallurgical Engineering Division Council.

Rhodium plating has marked a continuous growth of interest both for decorative purpose and engineering purpose. In engineering applications, it is especially concerned with the surfacing of electrical contacts where the contact surface is required to resist mechanical wear and at the same time maintain the reliable transmission of electrical signals over long period of applications. Rhodium plating is also made use of for providing a whiter finish on platinum goods and to impart a nontarnishing coating over silver products. Many electronic components are rhodium coated because of low electrical resistivity and high hardness.

In the formulation of this standard, assistance has been derived from ASTM B634 'Standard specification for electrodeposited coatings of rhodium for engineering uses' issued by the American Society for Testing and Materials (ASTM).

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

ELECTROPLATED COATINGS OF RHODIUM FOR ENGINEERING PURPOSES — SPECIFICATION

1 SCOPE

1.1 This standard covers requirements of electro deposited coatings of rhodium used for engineering purposes.

1.2 Coatings of rhodium covered by this standard are usually employed for the corrosion resistance, stable electrical contact resistance, wear resistance, reflectivity, and heat-resistance. Some typical applications for deposited rhodium coating, are given in Annex A.

2 REFERENCES

The Indian standard listed below are necessary adjuncts to this standard:

<i>IS No.</i>	<i>Title</i>
1985	Recommended practice for preparation of iron and steel for electroplating :
(Part 1) : 1980	High carbon steel (<i>first revision</i>)
(Part 2) : 1980	Low carbon steel (<i>first revision</i>)
(Part 3) : 1980	Iron casting (<i>first revision</i>)
3194 : 1980	Recommended practice for cleaning metals prior to electroplating (<i>first revision</i>)
3203 : 1982	Methods of testing local thickness electroplated coatings (<i>first revision</i>)
3656 : 1968	Code of recommended practice for mechanical polishing of metals for electroplating
9531 : 1980	Recommended practice for preparation of copper and copper-base alloys for electroplating
10173 : 1982	Recommended practice for preparation of zinc alloy die castings for electroplating

3 SIGNIFICANT SURFACE

The part of the article covered or to be covered by the coating and for which the coating is essential for serviceability and/or appearance. When necessary the significant surface shall be indicated on the drawing of the article, or by the provision of suitably marked samples.

NOTES

1 When significant surfaces are involved on which the specified thickness of coating cannot readily be controlled, such as threads, holes deep recesses, and bases of angles, it will be necessary to apply thicker coatings on the more accessible surfaces, or to use special racking, or both.

2 Variation in the coating thickness from point-to-point on a coated article is an inherent characteristic of electroplating processes. Therefore, the coating thickness will have to exceed the specified value at some points on the significant surfaces to ensure that the thickness equals or exceeds the specified value at all points. Therefore, the average coating thickness on an article will usually be greater than the specified value, how much greater is largely determined by the shape of the article and the characteristics of the electroplating process. Additionally, the average coating thickness on an article will vary from article to article within a production lot. Therefore, if all of the articles in a production lot are to meet the thickness requirement, the average coating thickness of the production lot as a whole will be greater than the average necessary to ensure that a single article meets the requirements.

4 CLASSIFICATION FOR COATINGS

4.1 Electro deposited coatings of rhodium on basis of thickness have been classified as follows:

<i>Class</i>	<i>Minimum Thickness, μm</i>
0.2	0.2
0.5	0.5
1	1
2	2
4	4
5	6.25

4.2 Information to be Given with an Enquiry and Order

Information to be supplied while ordering plating of articles in accordance with this standard, purchaser should furnish the information given in Annex B.

5 PRE-TREATMENT AND ELECTROPLATING

5.1 Defects in the surface of the basis metal, such as scratches, pits, nonconducting inclusions, and roll and die marks, may adversely affect the appearance and performance of the applied coatings. Such defects that persist in the finish despite the observance of good metal finishing practices shall not be a cause for rejection.

NOTE — Applied finishes generally perform better in service when the substrate over which they are applied is smooth and free from torn metal, inclusions, pores, and other defects. It is recommended that the specifications covering the unfinished product provide limits for those defects. A metal finisher often can remove defects through special treatments such as grinding, polishing, abrasive blasting, chemical treatments, and electropolishing. However, these are not normal in the treatment steps preceding the application of the finish. When they are desired, they are the subject of special agreement between the purchaser and the supplier.

5.2 Preparatory Procedures

The basis metals shall be subjected to such cleaning procedures as those are necessary to ensure a surface satisfactory for subsequent electroplating. It is recommended that the basis metals may be prepared as per the practices prescribed in IS 1985 (Part 1): 1980, IS 1985 (Part 2): 1980, IS 1985 (Part 3): 1980, IS 3194: 1980, IS 3656: 1968, IS 9531: 1980 and IS 10173: 1982.

5.3 Heat Treatment of Steel

Electroplating shall be applied after all basis metal heat treatments and mechanical operations have been completed.

5.3.1 Stress Relief Before Electroplating

Severely cold-worked steel parts, or parts made from steel of tensile strength 1 000 MPa (or corresponding hardness*) or greater that have been ground or subjected to severe machining after tempering, shall normally be stress-relieved. As a guide, the parts may be maintained for 30 minutes, preferably at the highest temperature which may be applied without adversely affecting their strengths. For parts made from certain types of steel, depending upon the nature of steel, a temperature of 190 to 210°C or temperature less than the tempering temperature of the particular type of steel for not less than 1 h may be adequate.

5.3.2 Heat Treatment Steels

5.3.2.1 For fully heat treated steels the stress relieving may be done at temperature not exceeding the tempering temperature of the type of steel used, for not less than 1 hour.

5.3.2.2 Some steels that have been carburized, flamehardened or induction-hardened and subsequently ground would be impaired by the treatment given in 5.3.1 and shall instead be stress relieved at a lower temperature and for a longer period of time, for example, at 170°C for greater than 1 h, depending upon the process of heat-treatment, nature of steel and tempering temperature.

5.3.3 Embrittlement Relief of the Electroplating

Components that are subject to fatigue or sustained loading stresses in service and made

from severely cold-worked steels or from steels of tensile strength 1 000 MPa (or corresponding hardness) or greater, shall be heat-treated after the coating is applied. Guidance is given in Table 1.

Table 1 Guidance on Heat Treatment of Steel Parts After Plating

Tensile Strength MPa	Maximum Sectional Thickness of Part mm	Minimum Period at 190 to 210°C hours
1 000 to 1 150	Less than 12	2
	12 to 25	4
	Over 25	8
1 150 to 1 400	Less than 12	4
	12 to 25	12
	Over 25 to 40	24
		Heat to commence within 16 h of plating
	Over 40	Requires experimental determination

5.4 Undercoatings

5.4.1 Copper alloys containing about 10% zinc, 1% beryllium, 2% tellurium, or 1% lead shall be treated in accordance with recommended practice for preparation of copper-base alloys as given in IS 9531: 1980 in order to prevent adhesion problems.

5.4.2 Corrosion or heat-resistant steels shall have an undercoating of 2.5 µm of nickel.

5.4.3 Wherever possible, a gold strike may be used over nickel prior to the final rhodium coating in order to improve adhesion and corrosion resistance and to prevent contamination of rhodium electrolyte.

6 COATING REQUIREMENTS

6.1 Thickness

The minimum thickness of Rhodium coatings on all significant surfaces (see 3) shall conform to the requirements of the specified class as given in 4.

6.2 Appearance

Electroplated coatings shall completely cover all surfaces as specified by the purchaser and shall (see 5.1) be free from clearly visible defects, such as blisters, pits, roughness, cracks, unplated areas, stains, etc. The extent to which defects may occur on non-significant surfaces shall be specified by the purchaser. When rack marks are unavoidable, their position on the surface shall be specified by the purchaser.

6.3 Adhesion

The rhodium coatings shall be free from blisters and peeled areas when tested in accordance with 8.2.

7 SAMPLING

7.1 Out of each lot of similar parts, a number of samples shall be selected at random. The size of the lot and the number of samples to be selected shall be agreed upon by the manufacturer and the purchaser. All the samples selected shall be visually examined for any defects referred to in 6.2. Lot shall be classified of conforming or not conforming to the agreed criteria.

8 METHODS OF TEST

8.1 Thickness

8.1.1 The thickness of a coating shall be measured at any point on the significant surface that can be touched by a ball of 20 mm in diameter. The microscopical method described in IS 3203 : 1982 may be used to measure the thickness of rhodium coating, and the copper undercoats. This method is not recommended for thickness less than 2.5 μm .

8.1.2 Non-destructive methods like beta back scatter or X-ray fluorescence may be used if it can be demonstrated that uncertainty of the measurement is less than 10 percent.

8.2 Adhesion

Adhesion of the coating shall be tested in accordance with one of the procedure given in 8.2.1 and 8.2.2.

8.2.1 Bend Test

Bend the samples through an angle of 180° on a diameter equal to the thickness of the specimen. Examine the bent specimen at 4 X magnification. If the deposit shows any signs of separation from any underplating or the basis metal, or if any plating from another layer can be seen at the bend area, then adhesion is not satisfactory. Because of the inherent stress in rhodium electrodeposits, the formation of cracks in the rhodium that do not result in flaking or peeling of the deposit shall not be considered as cause for rejection.

8.2.2 Quench Test

Heat the electroplated samples for 1 h min in an oven at $185 \pm 10^\circ\text{C}$ and then quench immediately in water at room temperature. If the coating blisters or peels, the adhesion is to be considered unsatisfactory.

NOTE — When rhodium coatings on zinc alloys are tested, an oven temperature of $150 \pm 10^\circ\text{C}$ shall be used.

8.3 Embrittlement Relief

Subject electroplated articles that have been relieved as specified in 5.3.1 to a sustained tension test. Suitable load may be applied for 48 h depending upon the nature and composition of steel as the load varies for conducting the tension test for different types of steel. Unless otherwise specified, hold parts under load for 48 h and then examine for cracks. If cracks develop on any plated part, reject the lot.

9 MARKING

9.1 The marking related to the coating shall include service grade and classification numbers as specified in this standard and the name or trade-mark of the manufacturer.

ANNEX A

(Clause 1.2)

TYPICAL APPLICATIONS FOR ELECTRODEPOSITED RHODIUM

<i>Application</i>	<i>Thickness Required</i> m
Reflectors	0.25
Light duty electrical contacts	0.25 to 0.50
Corrosion protection (mild)	0.25
Severe corrosion conditions	2.5
Severe wear electrical contacts	1 to 2.5

ANNEX B

(Clause 4.2)

INFORMATION TO BE GIVEN WITH AN ENQUIRY AND ORDER

B-1 MANDATORY INFORMATION

B-1.1 When ordering articles to be electroplated in accordance with this standard, the purchaser shall provide the following information:

- a) The number of this standard.
- b) The basis metal and the class of coating denoting the severity of the conditions it is required to withstand (*see 4.1*).
- c) The appearance required. Alternatively, samples showing the required finish or range of finish shall be supplied or approved by the purchaser.
- d) The corrosion test to be used, if any, shall be specified by the purchaser.
- e) The adhesion test to be used, if any, shall be specified by the purchaser.
- f) The extent to which defects shall be tolerated on non-significant surfaces, shall be specified by the purchaser.
- g) The significant surfaces shall be specified by the purchaser and indicated on

drawings of the parts or by the provision suitably marked specimens.

- h) When it is impossible to avoid rack or contact marks on significant surfaces, the position of those marks shall be approved by the purchaser.
- j) Sampling methods and acceptance levels shall be specified by the purchaser.

B-2 ADDITIONAL INFORMATION

B-2.1 The following additional information may be provided by the purchaser, when appropriate:

- a) The tensile strength of the steel and the need for heat-treatment, either before or after electroplating.
- b) In those cases, where thickness coatings other than those which are covered by this standard are required, the particular thickness desired shall be specified by the purchaser.
- c) The purchaser may specify thickness requirements on those points that cannot be touched by a ball 20 mm in diameter.

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